VERIFICATION OF TRANSLATION

International Application PCT/EP 03/13647 of 03.12.2003

I, (Name and address of translator)

Jean Laurent
La Rive
1426 Concise
Switzerland

am conversant in the English language and I state that the following is a true translation to the best of my knowledge and belief of the International Application PCT/EP 03/ 13647 dated December 3, 2003.

Signature of translator : _____

Dated : Marin, May 25, 2005

Case 2204
TR/ert

FINE ADJUSTING DEVICE FOR SPRUNG BALANCE

The present invention concerns fine regulating device for a sprung balance consisting in a particular arrangement of the index assembly to make adjusting the isochronism easier and more reliable in the long term. The invention also concerns a fine adjusting method, i.e. a succession of manipulations ranging from putting the watch into beat to the final adjustment, the initial and final manipulations being carried out by means of a single fine adjusting device owing to said particular arrangement.

In a known manner, an index assembly is made up of a set of parts mounted on the balance-cock, namely a balance-spring stud for securing the end of the outer curve of the balance-spring, and an index friction fitted onto the top balance endpiece comprising an extension beyond the balance-cock for the pins and/or the balance-spring buckle and at the other end a tail of the index on which a screw generally acts, against the return force of a spring, to rotate the index through small angles and thus modify the active length of the balance-spring.

The construction of the index assembly has given rise to a certain number of variants and improvements, particularly as regards the means for securing the external end of the balance-spring, and delimiting the active length of said balance-spring.

All of these constructions have in common the fact that the adjusting or securing means are generally complicated, which can make the adjusting operations difficult, particularly the fine adjustment of the isochronism.

It is thus an object of the invention to overcome the drawbacks of the prior art by providing a device that is much easier to handle owing to a particular arrangement of tightening/locking devices for adjusting the setting into beat and the rate by means of a single fine adjusting device. This arrangement also saves the use of a mobile stud-carrier for adjusting the setting into beat.

The invention therefore concerns a fine adjusting device for a sprung-balance. The balance, which, in a conventional manner, comprises poising screws screwed into its arms, has its axis pivoted between a plate and a balance-cock, whose top balance endpiece allows the friction fit mounting of an index that can be oriented, for example by means of a adjusting screw pressing onto the tail of the index against the return force of a spring. The balance-spring, pinned up to the collet in accordance with known means on the balance staff can be put into beat, adjusted as regards isochronism and have its outer curve fixed, owing to the fine adjusting screw and specific tightening/locking means on the balance cock and index whose features are explained hereinafter. The balance cock is provided with a first lug extended by a bent

stirrup whose feet extend as far as the outer curve of the balance spring and in which a first tightening device is hinged formed of an L shaped rocking element the small arm of which is manoeuvred by a flanged screw screwed into said lug to make the large arm pivot and to form a clamp for the end of the balance spring with the inner surface of the stirrup feet. The index comprises, on an extension opposite the index tail, a second tightening device having the same design as the first, namely a stirrup in which an L shaped rocking element is hinged, whose flanged screw forms a clamp, by being screwed in, for fixing a chosen location of the curve outside the balance spring in order to delimit the useful length thereof. The balance cock includes finally a second lug into which a third screw is screwed through an oblong aperture in an annular tongue extending on one side the extension of the index, said screw locking the index in a pre-determined position by screwing in/unscrewing the fine adjusting screw. The axis of all three tightening/locking screws is parallel to the balance staff and they are all accessible from the same side of the device, which facilitates the adjustment operations.

This construction also has the advantage of being able to exert a defined tightening force on the outer curve of the balance spring, substantially perpendicular to the buckle, and not causing any deformation of the latter while giving the surfaces opposite the clamps formed by a stirrup and an L-shaped rocking element the same curvature as that of the outer curve of the balance spring.

Other features and advantages of the present invention will appear in the following description, given by way of illustrating and non-limiting example, with reference to the annexed drawings, in which:

- Figure 1 is a top perspective view of a sprung balance according to a first embodiment of the invention;

- Figure 2 is a bottom perspective view of the sprung balance shown in Figure 1;

- Figure 3 is an enlarged bottom view of the tightening device along arrow III of Figure 2;

- Figures 4A and 4B show in cross-section, in an open position and a closed position the tightening device in the balance cock;

- Figure 5 shows a cross-section of the tightening device in the closed position at the index;

- Figure 6 is a top perspective view of a sprung balance according to a second embodiment of the invention;

- Figure 7 is a bottom perspective view of the index shown in Figure 6; and

- Figures 8, 9 and 10 are partial cross-sections along the lines VIII, IX and X of Figure 6.

Figures 1 and 2 show perspective, respectively top and bottom views, of a sprung balance according to a first embodiment of the invention, the assembly having to be secured to a plate of a mechanical watch movement (not shown). In this example, the balance 1 comprises two arms 1a, 1b into which poising screws 2a, 2b are screwed, its staff 3 being pivoted between a plate (not shown) and a balance cock 10. In a conventional manner, Figure 2 shows that balance 1 includes a small roller 6a, a large roller 6b with an impulse pin 6c, and that a collet 5 allows the curve at the centre of a balance spring 4 to be fixed to staff 3 of balance 1.

Referring more particularly to Figure 1, it can be seen that balance cock 10 carries an index 20, friction fitted onto top balance endpiece 10a and whose tail 20a allows its orientation to be altered owing to a fine adjusting screw 7 pressing on said tail of index 20a against the return force of a swanneck shaped spring 8, through one end of which, fixed in balance cock 10 by means of two screws 8a, said fine regulating screw 7 passes.

Balance cock 10 includes a first lug 11 provided with a first tightening device forming a clamp. This device is formed by a bent stirrup 12 integral with first lug 11 and whose feet 12a, 12b extend as far as balance spring 4, and in which an L-shaped rocking element 13 is hinged, which can be operated by a flanged tightening screw 19 to form a clamp used for immobilising the end of the outer curve 4a of balance spring 4. The detailed description and operation of this clamp assembly will be disclosed hereinafter.

Likewise, index 20 comprises a second tightening clamp device formed, opposite index tail 20a, by an extension 21 prolonged by a bent stirrup 22 in which an L-shaped rocking element is hinged, for clamping a portion of the outer curve 4a and thus defining the useful length of balance spring 4 by acting on a second flanged tightening screw 29. Extension 21 further comprises, on one of its sides, an annular tongue 31 extending above a second lug 30 of balance cock 10. Tongue 31 comprises an oblong aperture 32 into which there is screwed a screw 9 for locking index 20 in a determined position after the orientation thereof has been adjusted by means of fine adjusting screw 7.

As can be seen in this embodiment, the three screws 9, 19 and 29 and the two poising screws 2a, 2b are all accessible from the same side, along a direction parallel to the balance staff.

The clamps enabling the outer curve 4a of the balance spring 4 to be fixed are described with reference also to the partial bottom view of Figure 3 and to Figure 4A

showing in cross-section, along a line passing through the balance staff, the clamp formed at balance cock 10 by rocking element 13, said clamp being in the open position.

L-shaped rocking element 13 comprises a small arm 14, a large arm 15 and a hinge 13a formed, for example, by two studs engaged in corresponding apertures in stirrup 12 of balance cock 10.

Small arm 14 comprises a notch 14a delimited by a top lip 16 and a bottom lip 18. Top lip 16 comprises an inclined plane 16a directed towards the interior of notch 14a, said inclined plane 16a cooperating with an inclined plane 16b of tightening screw 19 to pivot rocking element 13, by unscrewing said screw, and opening the clamp. Bottom lip 18 is longer and extends under the flange of tightening screw 19, such that screwing said screw closes the clamp, as shown in Figure 4B.

Large arm 15 comprises at its base a shoe 17, the ends of which extend on each side facing the inner surface of feet 12a, 12b of stirrup 12. Shoe 17and feet 12a, 12b have the same curvature as the outer curve 4a of balance spring 4 such that tightening the clamp does not cause any deformation of the strip of the balance spring 4.

The clamp formed at index 20 by rocking element 23, shown in cross-section in the closed position in Figure 5, has exactly the same features as those previously described. Rocking element 23 operated by flanged tightening screw 29, comprises a small arm 24 with a notch 24a delimited by a top lip 26 with an inclined plane 26a cooperating with an inclined plane 26b of the flange of screw 29, a bottom lip 28 and a large arm 25 that ends, at its base, in a shoe 27 opposite feet 22a, 22b of stirrup 22.

Owing to the device that has just been described, it is possible to regulate the balance spring by carrying out, in succession, the operations set out hereinafter.

1. Putting into beat

First of all, screw 19 is unscrewed to open the clamp secured to balance cock 10 and screw 9 is loosened to make a first rough adjustment by rocking index 20. A fine adjustment is then made by manoeuvring screw 7 which acts on index tail 20a, then screw 9 and next screw 19 are tightened.

2. Adjustment of the isochronism

First of all, screw 29 is unscrewed to open the clamp secured to index 20, then screw 9 is loosened. The angle of attachment of balance spring 4 is then altered by manoeuvring fine adjusting screw 7 to optimise the isochronism, then screw 9, and next screw 19 are tightened again.

3. Rough adjustment

The rate is adjusted by means of poising screws 2a, 2b, which allow the moment of inertia of the balance to be altered.

4. Fine adjustment

First of all, screw 29 is unscrewed to open the clamp secured to index 20, then screw 19 is loosened. Acting on screw 7 can then carry out the fine adjustment. In this step, only slight variations in the isochronism can be expected. Finally, first of all screw 9, then screw 29 are tightened again.

As can be seen, with the exception of fine adjustment screw 7, all of the other screws for carrying out the adjustment are accessible from the same side.

With reference now to Figures 6 to 10, a second embodiment will be described hereinafter, which differs from that previously described essentially in the way in which the tightening devices are actuated. The common parts, i.e. those that have not undergone any significant modification, will bear the same references and will not be described again.

It can be seen first of all that index 20 has the simplified shape of an open ring that no longer comprises an index tail and nor, therefore, the adjusting device which was formed by screw 7 and the swanneck shaped spring 8. It will be observed that such a simplification would be equally applicable to the first embodiment. Index 20 comprises an annular ring 31 provided with an oblong aperture 32 in which there is engaged a screw 9 to be screwed into a lug 30 in balance cock 10 for immobilising index 20 in a given position as can be seen in Figure 9.

Index 20 also comprises an extension 21 on which there is mounted a tightening device that no longer includes a rocking element, but acts like a vise comprising two jaws 33, 35. An L-shaped fixed jaw 35 includes a small arm 34 fixed to extension 21 by being driven in or riveted by two studs 34a, 34b, and a large arm 36 through which a conical head screw 39 passes, for manoeuvring a mobile jaw 33 comprising a guide catch 33a on small arm 34. By screwing/unscrewing screw 39 in a direction parallel to the plate, it is thus possible to immobilise or release the outer curve of the balance spring 4 to carry out the adjustment operations.

In order to immobilise balance spring 4, a second tightening device forming a vise 45, identical to the first, is mounted on a plate 47 fixed to balance cock 10 by means of a screw 48a and a stud 48b. As previously, there is thus again a fixed jaw 45, and a mobile jaw 43 assembled via a conical head screw 49, enabling the sprung balance to be easily adjusted.

The operation of this second embodiment is identical to the first, and thus will not be described any further.

Without departing from the scope of the present invention, those skilled in the art can make alterations to the embodiments that have just been described, for example by giving the L-shaped rocking element a different shape or by changing the orientation thereof by 180°.